Application Note–AN0805A

The NetSensor VAV balancer program

This application note describes a method to balance air flow using a flow hood, NetSensor as a service tool and the balancer program included in KMC VAV controllers.

Related materials

In addition to the material presented in this application note, review and have available the following reference materials.

◆ Installation and operation guides for the applicable KMC VAV controllers
◆ The application note from The Digital Designer's Guide that is appropriate for each controller
◆ WinControl XL Plus User's Manual
◆ System plans with controller addresses

Additional equipment

The air flow balancing method described in this application note requires the following equipment:

◆ A flow hood or other accurate method to measure air flow.
◆ A NetSensor and cable for installations that use a temperature sensor instead of a NetSensor.

Overview

KMC VAV controllers are pre-programmed with NetSensor function keys defined to use to turn the NetSensor into a simple service tool. With this feature, a balance technician can:

◆ Adjust setpoints for minimum and maximum air flow
◆ Enter volume conversion factors
◆ View air flow readings
◆ When necessary, establish sensor correction factors.

In addition, the NetSensor can be used to override commands to the controller forcing control at either minimum or maximum setpoints as necessary to verify actual unit flow.

A balancer can use one of two methods to setup and calibrate KMC VAV controllers:

Adjusting airflow with WinControl software

If a computer is available, the most flexible method of defining minimum and maximum flow setpoints and sensor adjustment factors is with WinControl software to communicate directly with each controller. All user-programmable data is available using this method while security features allow limiting their access.

Using a NetSensor as a balancer service tool

The following items are factory programmed for access by the NetSensor service tool:

There are two different ways to use the NetSensor service tool. Primarily, the difference is whether or not the box needs to be commanded to control at a specified flow setting for checkout and verification of actual versus measured flow.

👉 **Note**

After balance parameters are set, save the program for each controller that has been configured. Save each panel individually or use the Save Network option in the Panel Menu.

1. Control box flow Using Normal Wall Mounted Thermostat. If the VAV controller is equipped with a standard room thermostat with a setpoint dial the box can be forced to minimum or maximum flow by adjusting the room setpoint. For example, a cooling box is commanded to minimum flow by adjusting the setpoint higher than the space temperature. Maximum flow can be achieved by setting the thermostat below the current space temperature.
2. Force Box Control Using NetSensor

The Program 4 in a KMD preprogrammed VAV controller is a balancer override routine. By enabling this program, the VAV controller is forced to control at either minimum flow or maximum flow.

Starting program 4
Starting program 4 depends upon the type of NetSensor in use.

NetSensors with LED displays Each NetSensor contains a pair of auxiliary contact wires located on the back of the unit. By connecting these two wires together the NetSensor will activate Program 4 in the controller and attempt to operate at either minimum flow or maximum flow settings as defined by button 2 on the NetSensor.

NetSensors with LCD displays NetSensors KMD–1161 and KMD–1181 do not have auxiliary wires. Press buttons 5 and 7 together and then press an up arrow or down arrow button to change auxiliary input from *Off* to *On* to activate Program 4.

☞ **Note**

When the Balancer Override routine takes control over the standard temperature control routine, accurate space temperature may not be maintained. Also note disable Program 4 *before* disconnecting the NetSensor to return control to the normal temperature sequence. The balancer routine will be canceled automatically after 30 minutes if the NetSensor is disconnected from the controller before the auxiliary contacts are opened.
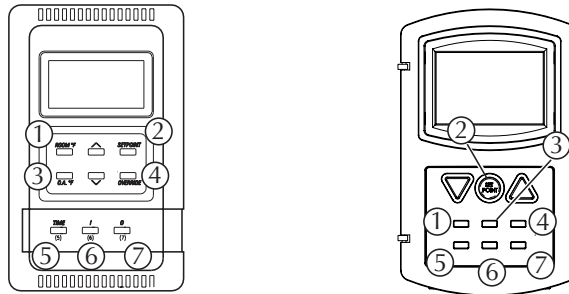

Illustration 6 NetSensor button numbers

Table 8 Button assignments

Button	Descriptor	Variable	Function
1	ROOMTEMP	1	Displays the temperature detected by the NetSensor. This value is not used in the balancing routine.
2-Normal	ACTIVESP	25	With Program 4 *Off* this button shows the active temperature setpoint.
2-Balancer	ACTIVESP	25	When program 4 is running, set this value to 0 for minimum air flow or 1 for maximum air flow. Negative numbers and numbers greater than 1 can be displayed for this button but these values will be corrected once the NetSensor updates its information with the connected controller. The controller will determine if the value is valid, and will display a legal value within 15 seconds.
3	VOLUME1	26	This is the controller measured flow reading with units corrected and volume converted into appropriate units.
4	VOLFACTR	21	Volume conversion factor This value multiplies directly against the Actual flow reading (which has been corrected for flow irregularities) to convert feet per minute into other units such as CFM. Typical volume conversion factors and an example of how to calculate these factors is included below.

Table 8 Button assignments (Continued)

Button	Descriptor	Variable	Function
5	MIN-FLOW	19	Minimum flow setpoint Displays the minimum flow setpoint for the VAV box. The default unit of measure is in Feet Per Minute. If volume factor is provided the units can be changed as required.
6		22	Sensor correction factor This value multiplies against the flow reading in feet per minute to correct for duct irregularities and tube placement.
7	MAX-FLOW	20	Maximum flow setpoint Displays the maximum flow setpoint for the VAV box. The default unit of measure is in Feet Per Minute. If volume factor is provided the units can be changed as required.

Example balance method

The following procedure is an example of how a VAV box might be balanced. Other methods may be used just as effectively. Always remember that there is up to 15 seconds between updates of the NetSensor. Modifications at the NetSensor will not take effect at the controller until an update has occurred. Follow these steps after plugging the NetSensor into the controller. The display should show a valid space temperature.

1. Determine the flow units desired and the box size. Enter the factor to convert Feet per minute into the desired units at button 4. The default value is 1.0.

Example 1:
The following example is for a 9-inch diameter duct (.375 foot radius) and for desired units in CFM.

$A = \pi^2$ where r is radius in Feet $\quad$ Or: $\quad A = \pi^2/256$ where E is diameter in Inches.
$\quad = 3.14 * .375^2 = .44$ Square Feet $\qquad = 3.14 * 9^2/576 = .44$ Square Feet

Enter .44 at button 4. This value is multiplied by the feet per minute flow in program 1 to arrive at CFM. The duct volume readout at button 3 will show flow in CFM units. Also, minimum and maximum flow must be defined in CFM values.

Example 2:
For a rectangular duct with a 10 inch height (H) and 12 inch width (W):

$$A = H * W / 144$$
$$= 10 * 12 / 144 = .83 \text{ Square Feet}$$

Enter .83 at button 4. This value is multiplied by the feet per minute flow in program 1 to arrive at CFM. The duct volume readout at button 3 will show flow in CFM units. Also, minimum and maximum flow must be defined in CFM values.

1. Set the minimum and maximum flow limits in button 5 and button 6 respectively.
2. Start the balance program by closing the switch on the auxiliary contact of the NetSensor. Or, adjust the room thermostat setpoint to command the unit to minimum or maximum flow as required.
3. Set button 2 (MIN 0 / MAX 1 button) to 1. This will place the flow setpoint at the maximum value as set in button 7. The box damper will drive to maintain the maximum flow setpoint. Wait for the value at button 3 to reach the setting for maximum CFM. Measure the flow from each supply louver to get the total supplied air at maximum. Differences between the displayed flow reading and field measurements may be due to sensor mounting location or turbulence. If the readings differ greatly, the flow reading can be adjusted by placing a multiplier in button 6. Use the following method to arrive at a the factor:

$$\text{Correction Factor (Button 6)} = \frac{\text{Actual Flow (Field Measurement)}}{\text{Controller Readout (Button 3)}}$$

If the measured volume is 200 CFM and the reading shown at button 3 is 180 CFM, then enter 1.11 at button 6 to increase the reading.

4. Set button 2 (MIN 0 / MAX 1 button) to 0. This will place the flow setpoint at the minimum value as set in button 5. The box damper will drive to maintain the minimum flow setpoint. Wait for the value displayed at button 3 to reach the setting for maximum CFM. Measure the flow from each supply louver to get the total supplied air at minimum. If the readings differ greatly, the flow reading can be adjusted by altering the minimum setpoint at button 5 to reach the desired reading.
5. Stop the balance program by opening the switch on the auxiliary contact on the NetSensor. Wait approximately 10 seconds for the unit to sense and recognize the open contact before disconnecting the NetSensor and moving to the next VAV box controller.